CLAIMS

WHAT IS CLAIMED:

1. A method, comprising:

receiving a current residual vector;

comparing the current residual vector to a plurality of historical residual vectors, each historical residual vector having an associated fault classification code;

selecting at least one of the historical residual vectors responsive to determining that the current residual vector matches at least one of the historical residual vectors; and

classifying a fault condition based on the fault classification code associated with the selected historical residual vector.

2. The method of claim 1, further comprising generating the current residual vector.

3. The method of claim 2, wherein generating the current residual vector further comprises:

determining expected values for a set of parameters;

determining actual values for the set of parameters; and

subtracting the actual values from the expected values to generate residual values for the set of parameters; and

generating the current residual vector based on the residual values for the set of parameters.

4. The method of claim 3, wherein determining the expected values for the set of parameters further comprises determining expected values for at least one tool parameter associated with a tool for processing a workpiece.

5. The method of claim 3, wherein determining the expected values for the set of parameters further comprises determining expected values for at least one characteristic of a workpiece.

6. The method of claim 3, wherein determining the expected values for the set of parameters further comprises determining expected values for at least one tool parameter associated with a tool for processing a workpiece and at least one characteristic of the workpiece.

7. The method of claim 1, wherein comparing the current residual vector to the plurality of historical residual vectors further comprises determining a distance between the current residual vector and the plurality of historical residual vectors, and determining that the current residual vector matches at least one of the historical residual vectors further comprises determining that the distance is less than a predetermined threshold.

8. The method of claim 7, wherein determining the distance further comprises determining a distance between ends of the current residual vector and ends of the historical residual vectors.

9. The method of claim 7, wherein determining the distance further comprises projecting the current residual vector onto the historical residual vectors.

10. The method of claim 9, wherein projecting the current residual vector comprises determining a scalar product of the current residual vector and the historical residual vectors.

11. The method of claim 7, wherein determining the distance further comprises determining an angle between the current residual vector and each of the historical residual vectors.

12. The method of claim 1, further comprising normalizing the current residual vector prior to comparing the current residual vector to the plurality of historical residual vectors.

13. The method of claim 1, further comprising:

determining that the current residual vector does not match any of the historical residual vectors; and

generating a new historical residual vector based on the current residual vector.

14. The method of claim 13, further comprising determining a fault classification code for the new historical residual vector.

15. The method of claim 1, further comprising scaling the current residual vector based on the larger of the current residual vector and the historical residual vector to which the current residual vector is being compared.

16. The method of claim 1, further comprising updating the selected historical residual vector based on the current residual vector.

17. The method of claim 16, wherein updating the selected historical residual vector further comprises averaging the selected historical residual vector and the current residual vector based on a weighted average.

18. The method of claim 16, wherein updating the selected historical residual vector further comprises averaging the selected historical residual vector and the current residual vector based on an exponentially weighted average.

19. The method of claim 1, further comprising:

selecting a plurality of historical residual vectors responsive to determining that the current residual vector matches the plurality of historical residual vectors; and

identifying one of the selected plurality of historical residual vectors as a most likely match to the current residual vector.

20. The method of claim 19, further comprising identifying remaining ones of the plurality of historical residual vectors as possible matches to the current residual vector.

21. The method of claim 1, further comprising:

receiving a plurality of current residual vectors;

comparing the plurality of current residual vectors to the plurality of historical residual vectors;

identifying a trend in the current residual vectors approaching at least one of the plurality of historical residual vectors; and

identifying a potential condition responsive to identifying the trend.

22. A system, comprising:

a fault detection unit adapted to generate a current residual vector; and

a fault classification unit adapted to receive the current residual vector, compare the current residual vector to a plurality of historical residual vectors, each historical residual vector having an associated fault classification code, select at least one of the historical residual vectors responsive to determining that the current residual vector matches at least one of the historical residual vectors, and classify a fault condition based on the fault classification code associated with the selected historical residual vector.

23. The system of claim 22, wherein the current residual vector comprises residual values for a set of parameters generated by subtracting actual values for the set of parameters from expected values for the set of parameters.

24. The system of claim 23, wherein the set of parameters further comprises at least one tool parameter associated with a tool for processing a workpiece.

25. The system of claim 23, wherein the set of parameters further comprises at least one characteristic of a workpiece.

26. The system of claim 23, wherein the set of parameters further comprises at least one tool parameter associated with a tool for processing a workpiece and at least one characteristic of the workpiece.

27. The system of claim 22, wherein the fault classification unit is further adapted to determine a distance between the current residual vector and the plurality of historical residual vectors and determine if the distance is less than a predetermined threshold to determine if the current residual vector matches at least one of the historical residual vectors.

28. The system of claim 27, wherein the fault classification unit is further adapted to determine a distance between ends of the current residual vector and ends of the historical residual vectors.

29. The system of claim 27, wherein the fault classification unit is further adapted to project the current residual vector onto the historical residual vectors.

30. The system of claim 29, wherein the fault classification unit is further adapted to determine a scalar product of the current residual vector and the historical residual vectors.

31. The system of claim 27, wherein the fault classification unit is further adapted to determine an angle between the current residual vector and each of the historical residual vectors.

32. The system of claim 22, wherein the fault classification unit is further adapted to normalize the current residual vector prior to comparing the current residual vector to the plurality of historical residual vectors.

33. The system of claim 22, wherein the fault classification unit is further adapted to generate a new historical residual vector based on the current residual vector responsive to determining that the current residual vector does not match any of the historical residual vectors.

34. The system of claim 33, wherein the fault classification unit is further adapted to associated a fault classification code with the new historical residual vector.

35. The system of claim 22, wherein the fault classification unit is further adapted to scale the current residual vector based on the larger of the current residual vector and the historical residual vector to which the current residual vector is being compared.

36. The system of claim 22, wherein the fault classification unit is further adapted to update the selected historical residual vector based on the current residual vector.

37. The system of claim 36, wherein the fault classification unit is further adapted to average the selected historical residual vector and the current residual vector based on a weighted average.

38. The system of claim 36, wherein the fault classification unit is further adapted to average the selected historical residual vector and the current residual vector based on an exponentially weighted average.

39. The system of claim 22, wherein the fault classification unit is further adapted to select a plurality of historical residual vectors responsive to determining that the current residual vector matches the plurality of historical residual vectors and identify one of the selected plurality of historical residual vectors as a most likely match to the current residual vector.

40. The system of claim 39, wherein the fault classification unit is further adapted to identify remaining ones of the plurality of historical residual vectors as possible matches to the current residual vector.

41. The system of claim 21, wherein the fault detection unit is further adapted to generate a plurality of current residual vectors, and the fault classification unit is further adapted to compare the plurality of current residual vectors to the plurality of historical residual vectors, identify a trend in the current residual vectors approaching at least one of the plurality of historical residual vectors, and identify a potential fault condition responsive to identifying the trend.

42. A system, comprising:

means for receiving a current residual vector;

means for comparing the current residual vector to a plurality of historical residual vectors, each historical residual vector having an associated fault classification code;

means for selecting at least one of the historical residual vectors responsive to determining that the current residual vector matches at least one of the historical residual vectors; and

means for classifying the fault condition based on the fault classification code associated with the selected historical residual vector.